HAYEF: Journal of Education

RESEARCH ARTICLE

Comparison of the 21st Century Skills and Climate Literacy: A Study on the Gifted and Undiagnosed Gifted Secondary School Students

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Abstract

The purpose of the study was to compare the 21st century skills and climate literacy skills of gifted and undiagnosed gifted secondary school students. The survey model, one of the quantitative research methods, was utilized in the study. The study was implemented with a total of 376 secondary school students, 183 of whom were gifted and 193 of whom were undiagnosed gifted, who were selected through the model of convenient sampling. "Personal information form," "climate literacy scale," and "21st century skills scale" were all used as data collection tools in the study. For the analysis of the data, descriptive statistics, independent sample *t*-test and regression analysis were used. As far as the results obtained from the study are concerned, it was revealed that there was a significant difference in favor of the gifted students in terms of the sub-dimensions of the 21st century skills scale and the gender variable in general. Similarly, it was also found that there was a significant difference in favor of the gifted students regarding the general climate literacy scale and in terms of the sub-dimensions, between the groups and by the gender variable. Furthermore, the study results revealed that while the 21st century skills and the giftedness diagnosis status had a significant effect on the climate literacy, it had no regulatory effect.

Keywords: 21st century skills, climate literacy, gifted students, secondary school students

Introduction

The technological developments, innovations, and changes in this day and age have a direct impact on the daily life of human beings. The effort to adapt to the innovations manifests itself in all spheres of life. Presently, the skills, attitudes, and behaviors expected from individuals have highlighted the concept of "qualified people" with the acquisition of different skills rather than mere acquisition of knowledge. This state of affairs directly affects both the daily life skills and perspectives in different fields. From economy to social life, from artistic activities to education, the general purpose is to raise qualified individuals who are productive, creative, professionally equipped, adaptable to change, and have effective individual as well as cooperative communication skills. Skills and competencies expected from the qualified individuals have now been redefined and referred to as 21st century skills.

Many organizations and researchers around the world have worked on the 21st century skills and aimed to identify the competency areas in this field. The Organization for Economic Cooperation and Development (OECD), one of these organizations, has managed to gather these fields under the transformative skills with the project it has developed. Students are expected to have various knowledge, skills, and attitudes in the fields identified as "generating new values," "taking responsibility," and "coping with difficulties and tensions" (OECD,

2018). The Assessment and Teaching of 21st Century Skills Framework (ATSC21) collected the skills it revealed in four areas as "thinking," "doing business," "technology-based thinking," and "understanding the world" (Binkley et al., 2010). The International Educational Technologies Association (ISTE) classified the standards that the students were expected to achieve as ''competent learner," "digital citizenship," "knowledge constructor," "creative designer," "computational thinker," "creative communicator," and "global collaborator" (ISTE, 2016). Furthermore, the Iowa Education District units in the United States identified the 21st century skills as five different competencies of "civic literacy," "employability," "financial literacy," "health literacy," and "technology literacy" (Iowa Core, 2010). The 21st Century Skills Framework (Partnership for 21st Century Skills [P21]) highlighted the skills of "learning and innovation skills," "information, media, and technology skills," and "life and career skills" in order to support the versatile development of students (P21, 2007). In various studies regarding the definition of 21st century skills, Beers (2011) emphasized the skills of "generating new ideas," "critical thinking and problem solving," "communication, cooperation, and knowledge management," "effective and efficient use of technology," "career and life skills"; Wagner (2008) the skills of "cultural awareness," "critical and problem solving," "collaboration," "mental activity and flexibility," "taking responsibility and entrepreneurship," "communication skills," "ability to access and use

information," and Voogt and Roblin (2012) as the prominent skills that should be included in the interdisciplinary field and that "creative solutions" should be generated for complex problems. Furthermore, Kang et al. (2010) considered these skills in three dimensions as "cognitive," "affective," and "sociocultural" domains.

Cognitive Domain

These are the skills for generating and managing knowledge and developing problem-solving skills. This area emphasizes that students can use their high-level thinking skills more in the process.

Affective Domain

It includes the development of personal judgment systems by highlighting the individual characteristics of the students. Specifically, the development of self-regulation skills is emphasized.

Sociocultural Domain

It involves the development of social skills such as empathy and social sensitivity by strengthening the social relations of students. It essentially aims to have the students take an active role in the cooperative learning process.

It is clear that the skills and competencies expected from individuals in the 21st century appeal to people of all age groups. At present, the concept of literacy, which includes the skills of questioning, problem-solving, and the ability to organize their own lives, is highlighted (O'Brien & Rugen, 2001). Different types of literacies have emerged with the awareness of individuals as an informed individual by meeting their needs for themselves and producing creative solutions to problems (Aydemir et al., 2019). One of these literacy types that is highlighted is the climate literacy (Görgülü-Arı & Arslan, 2020). Climate literacy aims to raise individuals who recognize the basic principles of the climate system, know how to scientifically evaluate reliable information about climate, can make informed decisions in order to minimize the effects of climate change, and have advanced environmental attitudes and behaviors in accordance with the sustainability principle (Mochizuki & Bryan, 2015). In the study conducted by the Global Change Research Program (USGCRP) in the United States, one of the leading countries in climate literacy, the main competence areas of climate literacy were identified as "life and climate," "how do we know?," "earth's power source," "complex interaction," "variability and change," "human activities," and "decision making" (USGCRP, 2009). In Turkey, on the other hand, in their study on secondary school students, Yakar and Karakuş (2020) gathered the skills in six areas of "climate-related concepts," "basic information about climate," "national and local climate knowledge," "relationship between climate and life," "skills," and "attitudes and values." With these different classifications, individuals were expected to have certain competencies regarding the climate literacy and basic concepts in the climate system.

While climate change and many negativities present in the world highlight the awareness of teachers and students about literacy awareness (Shepardson et al., 2012), the development of climate literacy from early childhood brings along the structured process together with climate education. Nevertheless, since climate education is an approach that has recently started to generate its own identity, it is not possible to talk about a universally standardized curriculum yet. In this context, in Turkey, the "Environmental Education and Climate Change" curriculum (MEB, 2022) was prepared at the secondary school level by the Ministry of National Education (MEB) in 2022, and in 2023, in the "21st Century Skills and Values Research Report" developed in the "Research Report on 21st Century Skills and Values" in 2023, some environmental literacy competencies (MEB, 2023) were identified. The main purpose of these studies was to increase the awareness of individuals about the environment in which they live. In this sense, in addition to individual responsibilities, different ecological perspectives

are required in order to prevent climate changes, to develop new perspectives on environmental problems, and to present creative solutions (Wibeck, 2014). Cognitive, and emotional characteristics should be prioritized, and active learning strategies should be adopted for students to have certain competencies about climate (Doğar & Başıbüyük, 2005). In this respect, while the fact that especially global problems are emphasized from an early age (Davis et al., 2014; Galbraith, 1985; Passow, 1988; Piechowski, 1997; Schroth & Helfer, 2017; Silverman, 1994), their sensitivity toward environmental problems (Aydın et al., 2011), using problem-focused coping strategies before their peers by producing original solutions when faced with a problem situation (Reis & Moon, 2002; Sak, 2011; Silverman, 2003), and increasing their probability of becoming adults who produce solutions to future problems in the coming years (Cross, 2011; Oğurlu et al., 2016; Silverman, 1994; Van der Meulen et al., 2014) increase their probability of becoming adults who produce solutions to the future problems in the coming years (Cross, 2011; Oğurlu et al., 2016; Silverman, 1994; Van der Meulen et al., 2014), at the same time, it makes it significant to structure this potential of gifted children with the 21st century skills.

When the characteristics of the gifted are considered together with the skills of the 21st century, it is possible to ensure that they can highlight different strategies for climate change, which is among the important problems of today. Similarly, Karakuş (2006) emphasized the implementation of comprehensive practices in order for students to obtain information on climate issues more easily and to enable them to access this information themselves. In this sense, it is believed that it is important for the academic and social development of gifted students to identify both their 21st century skills and their competencies for climate literacy by comparing them with their peers who are undiagnosed gifted children. In this sense, the aim of this study is to contribute to the relevant literature by examining the predictive effect of 21st century skills on climate literacy and the regulatory effect of giftedness diagnosis status of the students in this relationship. When the studies in the relevant literature are reviewed, it is clear that while the 21st century skills were dealt with together with early childhood students (Çetin & Çetin, 2021; Dinler et al., 2021), secondary school students (Bozkurt & Çakır, 2016; Murat, 2018; Önür & Kozikoğlu, 2019), high school students (Göktepe-Yıldız, 2020), teachers (Çolak, 2018), teachers and teacher candidates (Başar, 2018), studies (Nacaroğlu, 2020) comparing gifted-diagnosed and gifted-undiagnosed students on the same subject are limited. As far as the previous studies are concerned, while Göktepe-Yıldız (2020) found that there was a positive significant difference between the 21st century skills and academic achievement of the students, Nacaroğlu (2020) reported that the 21st century skills of the gifted students were leadership, critical thinking, knowledge and skills compared to their peers who were undiagnosed gifted students. It was found that there was a significant difference in the dimensions of technology literacy, entrepreneurship and innovation, and social responsibility. Previous studies revealed that there was a significant difference in the academic and social skills of the 21st century skills of gifted students. In the present study, it was aimed to identify the 21st century skills of students who were diagnosed gifted and undiagnosed gifted and evaluate their effects on the climate literacy. In addition to the 21st century skills, the studies conducted revealed that in terms of the climate literacy, the gifted were associated with climate change and basic scientific process skills (Sanad et al., 2021), that their views on the earth system were identified (Park & Chung, 2014), that their cognitive structures on climate change were examined (Mutlu & Nacaroğlu, 2019; Nacaroğlu & Karaaslan, 2020), and that their project-based climate literacy competencies (DeWaters et al., 2014), identifying critical and creative perspectives on global climate change (Akhan et al., 2022) and their views on global warming were examined. Similarly, there are also studies in the relevant literature in which the attitudes of students who were diagnosed gifted and those

were undiagnosed gifted (Uğulu, 2013) and their perceptions of bio-diversity were compared through metaphors (Özarslan, 2020). In the relevant literature, no study has been encountered in which the 21st century skills and climate literacy of the gifted and their undiagnosed gifted peers were discussed together, and it was found that only the 21st century skills (Bozkurt & Çakır, 2016; Kan'an, 2018; Karakaş, 2015; Nacaroğlu, 2020; Önür & Kozikoğlu, 2019) contributed to the relevant literature by considering the gender and/or class of education variable. It was found that the gender variable discussed in these studies was compared within their own groups of students who were diagnosed gifted and those who were undiagnosed. In the present study, it was aimed to contribute to the relevant literature by comparing the students who were diagnosed gifted and those who were undiagnosed, according to the gender variable. Furthermore, with this study, it was aimed to identify and compare the 21st century skills and climate literacy competencies of students who were diagnosed gifted and those who were undiagnosed, to contribute to the realization of necessary instructional measures and administrative intervention for the gifted students, and eventually to guide the educators in structuring the educational activities for the academic and social life skills of the students by revealing the educational needs of the students and evaluating these competence areas in terms of the curriculum.

In this respect, answers were sought for the following sub-objectives by examining the sub-components of "cognitive domain," "affective domain," "sociocultural domain" for students' 21st century skills, and "climate concept," "climatic awareness," and "climatic consciousness" for climate literacy skills:

1. Does the 21st century skills and sub-components (cognitive, affective, and sociocultural domains) of the diagnosed gifted and undiagnosed gifted secondary school students differ significantly?
2. Does the 21st century skills and sub-components of the diagnosed gifted and undiagnosed gifted secondary school students differ significantly by gender?
3. Do the climate literacy and its sub-components (climate concept, climatic awareness, and climatic consciousness) of the diagnosed gifted and undiagnosed gifted secondary school students differ significantly?
4. Do the climate literacy skills of the diagnosed gifted and undiagnosed gifted secondary school students differ significantly by gender?
5. Does the 21st century skills and giftedness diagnosis have a predictive effect on the climate literacy?
6. Does the giftedness diagnosis have a regulatory effect on the relationship between 21st century skills and climate literacy?

Methods

Research Patterns

In the study, the relational survey model, one of the quantitative research designs, was used since it was aimed to examine the comparison of the 21st century skills and climate literacy skills of gifted and undiagnosed gifted secondary school students by groups and to explicate to what extent the 21st century skills of the groups predicted the climate literacy skills. The studies conducted based on the relational survey model aim to reveal the relationship between two or more variables (Büyüköztürk et al., 2015).

Participants

The study was conducted in the second semester of the 2021-2022 academic year with a total of 183 gifted students studying at the Science and Art Center (BİLSEM), selected through convenient sampling in two different provinces in the Northeastern Anatolia Region of Turkey (Development Agencies, 2020). It was implemented with the participation of a total of 376 students, 193 of whom were undiagnosed

gifted secondary school students, studying in the province. The reason for choosing the convenient sampling method used in the study was that it provided convenience in terms of such factors as time, labor, and transportation (Büyüköztürk et al., 2015). Information regarding the gender and grade levels of the gifted and undiagnosed gifted students who participated in the study were included in Table 1.

Table 1.
Demographic Information of the Study Group

		n	*%*
Gender	Female	202	53.7
	Male	174	46.3
Age (years)	10	37	9.8
	11	116	30.9
	12	100	26.6
	13	123	32.7
Class level	Fifth grade	135	35.9
	Sixth grade	93	24.7
	Seventh grade	78	20.7
	Eighth grade	70	18.6
Group	Gifted students	183	48.7
	Undiagnosed gifted students	193	51.3

As far as Table 1 is concerned, there were 183 students in total, 98 (53.6%) female and 85 (46.4%) male students in the group of gifted students participating in the study. Regarding the grade levels, fifth grade students consisted of 94 (51.4%) students, sixth grade students 41 (22.4%) students, seventh grade students 28 (15.3%) students, and eighth grade students 12 (10.9%).

There was a total of 193 students, 104 (53.9%) female and 89 (46.1%) male students, in the group of students who were undiagnosed gifted students. Regarding the grade levels, fifth grade students consisted of 41 (21.2%) students, sixth grade students 52 (26.9%) students, seventh grade students 50 (25.9%) students, and eighth grade students 50 (25.9%) students.

Data Collection Tools

Personal Information Form
The form consisted of three questions regarding the information concerning the gender characteristics of the students participating in the study, their status as Science and Art Center students, and their grade level.

21st Century Skills Scale
The "21st Century skills scale," developed by Kang et al. (2010) and adapted into Turkish by Karakaş and Anagün (2020), consisted of 3 sub-dimensions and 32 items. The sub-dimensions in the scale were cognitive (12 items), affective (10 items), and sociocultural (10 items). The scale was a 5-point Likert type scale, with "1" I totally disagree, "2" I disagree, "3" I am undecided, "4" I agree, and "5" I totally agree. The lowest score that was possible to obtain from the overall scale was 32, and the highest score was 160. The internal consistency coefficients of the sub-dimensions in the scale were calculated, and it was found that the Cronbach's alpha coefficients were 0.77 in the cognitive domain sub-dimension, 0.70 in the affective domain sub-dimension, and 0.67 in the sociocultural domain sub-dimension.

Climate Literacy Scale
The scale developed by Görgülü-Arı and Arslan (2020) had a structure consisting of 24 items in total with 3 factors. There were 10 items in the concept of climate sub-dimension, 8 items in the climatic awareness sub-dimension, and 6 items in the climatic consciousness sub-dimension. The scale was a 5-point Likert type scale, with "1"

Strongly Disagree, "2" Partially Disagree, "3" Undecided, "4" Partially Agree, and "5" Strongly Agree. The lowest score to be obtained from the overall scale was 24, and the highest score was 120. Internal consistency coefficients of the sub-dimensions in the scale were calculated, and it was found that the Cronbach's alpha coefficients were 0.77 in the concept of climate sub-dimension, 0.70 in the climatic awareness sub-dimension, and 0.67 in the climatic consciousness sub-dimension. The Cronbach's alpha coefficient for the entire scale was calculated as 0.89.

Reliability Analysis

In the study, the Cronbach's alpha coefficients were calculated in an attempt to identify the reliability levels of the 21st century skills and climate literacy scales. As a result of the analysis, the Cronbach's alpha coefficient of the 21st century skills scale was calculated as 0.72 and the Cronbach's alpha coefficient of the climate literacy scale was calculated as 0.79. Therefore, it was found that the scales used in the study were reliable.

Data Analysis

Prior to the analysis of the data obtained in the study, in an attempt to establish whether the data showed a normal distribution, initially, skewness and kurtosis values were examined and it was checked whether the values obtained were between -2 and $+2$ (George and Mallery, 2010). Subsequently, it was checked whether the values obtained by dividing the kurtosis and skewness values by the standard error were between -1.96 and 1.96 (Büyüköztürk, 2011) and the extreme values obtained at the end of the normality test were checked. Table 2 illustrates the values used to establish whether the scores obtained from the scales of the gifted and undiagnosed gifted students who participated in the study demonstrated a normal distribution.

Table 2.
Normality Test Results Regarding the Score Distribution

	Undiagnosed Gifted Students		Gifted Students	
	Skewness	**Kurtosis**	**Skewness**	**Kurtosis**
Cognitive	−0.66	0.06	−0.37	0.05
Affective	−0.88	−0.15	−1.31	1.49
Sociocultural	−0.52	−0.42	−0.85	1.50
21st century skills	−0.84	0.10	−0.96	0.94
Concept of climate	−0.74	−0.30	−0.96	1.30
Climatic awareness	−0.63	−0.77	−0.75	2.23
Climatic consciousness	−0.36	−0.73	−0.16	0.84
Climate literacy	−0.56	−0.64	−1.11	1.75

The skewness and kurtosis values of all variables were between -2 and $+2$ when we evaluated for both the gifted and undiagnosed gifted students. Among the student groups participating in the study, it was revealed that the data obtained from the 21st century skills scale and climate literacy scale demonstrated a normal distribution by the gender variable. Descriptive analysis for the demographic information and percentage distributions of the students participating in the study, and the independent sample *t*-test were used in order to compare the data obtained from the 21st century skills and climate literacy scales with various variables. Finally, various regression analyses were applied in an attempt to see the predictive effect of 21st century skills and special talent identification status on climate literacy, as well as to see whether the giftedness status had a moderator effect on the relationship between 21st century skills and climate literacy. Initially, the hypotheses related to the multiple hierarchical regression analysis were tested (Baron & Kenny, 1986), and afterward, the same assumptions were verified with the PROCESS macro (Hayes, 2018) using the resampling method.

Ethical Permission for Research

In this study, data were collected with the permission of Kafkas University Ethics Committee (Date: April 21, 2022, Number: 16). The consent form was included in the first part of the scale forms used in the study. The research was conducted on a voluntary basis.

Results

The findings obtained as a result of the analyses made within the scope of the study are presented below.

Comparison of the 21st Century Skills Scores of Gifted and Undiagnosed Gifted Secondary School Students

In the study, the results of the comparison of the 21st century skills score of the gifted and undiagnosed gifted secondary school students are illustrated in Table 3.

Table 3.
Independent Sample t-Test Results on 21st Century Skills Scores of the Gifted and Undiagnosed Gifted Secondary School Students

Sub-dimensions	Groups	N	$\bar{x}$	SD	df	t	p
Cognitive domain	Gifted students	183	3.79	0.25	374	8.75	.00
	Undiagnosed gifted students	193	3.50	0.37			
Affective domain	Gifted students	183	3.83	0.21	374	6.93	.00
	Undiagnosed gifted students	193	3.60	0.40			
Sociocultural domain	Gifted students	183	3.75	0.26	374	7.00	.00
	Undiagnosed gifted students	193	3.51	0.40			
Overall scale	Gifted students	183	3.79	0.18	374	9.79	.00
	Undiagnosed sifted students	193	3.53	0.31			

When Table 3 is examined, it is clear that there was a significant differences in favor of the gifted secondary school students in terms of the scores obtained from the 21st century skills scale (t (374)$=9.79$, $p < .05$). Furthermore, it was revealed that there was a significant differences in favor of gifted students in the sub-dimensions of the cognitive domain (t (374)$=8.75$, $p < .05$), affective domain (t (374)$=6.93$, $p < .05$) and sociocultural domain (t (374)$=7.00$, $p < .05$) in the 21st century skills scale. In terms of the average score in the 21st century skills scale of the gifted secondary school students in the study, it was found that the highest level of participation was the affective domain ($\bar{x}=3.83$), while the lowest level of participation was the sociocultural domain ($\bar{x}=3.75$). In the mean scores of the 21st century skills scale of undiagnosed gifted secondary school students, it was found that the sub-dimension they participated in the lowest level was the cognitive domain ($\bar{x}=3.50$), and the sub-dimension they participated in the highest level was affective domain ($\bar{x}=3.60$).

Analysis of 21st Century Skill Scores of the Gifted and Undiagnosed Gifted Secondary School Students by Gender Variable

The results of the analysis of the 21st century skill scores of the gifted and undiagnosed gifted secondary school students by gender variable are presented in Table 4.

As far as Table 4 is concerned, a significant difference emerged in favor of the gifted female students regarding the sub-dimensions of cognitive domain (t (200)$=4.44$, $p < .05$), affective domain (t (200)$=3.35$, $p < .05$), sociocultural domain (t (200)$=3.72$, $p < .05$) in the 21st century skills scale, and in the scale overall (t (172)$=9.32$, $p < .05$). There was a significant differences in favor of the gifted male students regarding the sub-dimensions of cognitive domain (t (172)$=8.09$,

Table 4.
Independent Sample t-*Test Results Regarding the Analysis of the 21st Century Skill Scores of the Students by Gender Variable*

Gender	Sub-dimensions	Groups	N	$\bar{x}$	SD	df	t	p
Female	Cognitive	Gifted students	98	3.76	0.25	200	4.44	.00
		Undiagnosed gifted students	104	3.57	0.36			
	Affective	Gifted students	98	3.81	0.23	200	3.35	.00
		Undiagnosed gifted students	104	3.65	0.40			
	Sociocultural	Gifted students	98	3.74	0.25	200	3.72	.00
		Undiagnosed gifted students	104	3.57	0.39			
	Overall scale	Gifted students	98	3.77	0.20	200	4.85	.00
		Undiagnosed gifted students	104	3.60	0.30			
Male	Cognitive	Gifted students	85	3.82	0.26	172	8.09	.00
		Undiagnosed gifted students	89	3.42	0.37			
	Affective	Gifted students	85	3.87	0.19	172	6.55	.00
		Undiagnosed gifted students	89	3.55	0.41			
	Sociocultural	Gifted students	85	3.78	0.27	172	6.16	.00
		Undiagnosed gifted gtudents	89	3.45	0.40			
	Overall scale	Gifted students	85	3.82	0.17	172	9.32	.00
		Undiagnosed gifted students	89	3.47	0.30			

$p < .05$), affective domain (t (172)=6.55, $p < .05$), and sociocultural domain (t (172)=6.16, $p < .05$) in the 21st century skills scale and the scale overall (t (172)=9.32, $p < .05$).

Comparison of Climate Literacy Skills Scores of the Gifted and Undiagnosed Gifted Secondary School Students

In the study, the results of the climate literacy scores of the gifted and undiagnosed gifted secondary school students are illustrated in Table 5.

Table 5.
Independent Sample t-*Test Results on the Climate Literacy Scores of the Gifted and Undiagnosed Gifted Secondary School Students*

Sub-dimensions	Groups	N	$\bar{x}$	SD	df	t	p
Concept of climate	Gifted Students	183	3.88	0.21	374	9.29	.00
	Undiagnosed gifted students	193	3.55	0.43			
Climatic awareness	Gifted students	183	3.92	0.21	374	11.84	.00
	Undiagnosed gifted students	193	3.37	0.59			
Climatic consciousness	Gifted students	183	3.88	0.32	374	11.07	.00
	Undiagnosed gifted students	193	3.39	0.50			
Overall scale	Gifted students	183	3.89	0.15	374	14.16	.00
	Undiagnosed gifted students	193	3.45	0.39			

Considering Table 5, it is apparent that there was a significant differences in favor of the gifted secondary school students in terms of the scores obtained from the general climate literacy scale (t (374)=14.16, $p < .05$). Furthermore, there were significant differences in favor of the gifted students regarding the concept of climate (t (374)=9.29, $p < .05$), climatic awareness (t (374)=11.84, $p < .05$) and climatic consciousness (t (374)=11.07, $p < .05$) in the climate literacy scale sub-dimensions.

While it was found that the sub-dimension with the highest average in terms of the average score in the climate literacy scale of the gifted secondary school students was climatic awareness ($\bar{x}$=3.92), the sub-dimensions with the lowest average were climatic consciousness and concept of climate ($\bar{x}$=3.88). Meanwhile, it was found that the sub-dimension with the lowest average of the undiagnosed secondary school students was climatic awareness ($\bar{x}$=3.37), while the sub-dimension with the highest average was the climate concept ($\bar{x}$=3.55).

Examination of the Climate Literacy Skill Scores of the Gifted and Undiagnosed Gifted Secondary School Students by Gender Variable

The results of the analysis of the climate literacy scores of the gifted and undiagnosed gifted secondary school students by gender variable are presented in Table 6.

When Table 6 is examined, it turned out that there was a significant differences in favor of the female students regarding the sub-dimensions of concept of climate (t (200)=6.65, $p < .05$), climatic awareness (t (200)=7.67, $p < .05$), and climatic consciousness (t (200)=6.17, $p < .05$) in the climate literacy scale sub-dimensions and the overall scale (t (200)=9.31, $p < .05$). Furthermore, it was also revealed that there was a significant differences in favor of the gifted students regarding the concept of climate (t (172)=6.52, $p < .05$), climatic awareness (t (172)=9.20, $p < .05$) and climatic consciousness (t (172)=9.72, $p < .05$) sub-dimensions and the overall scale (t (172)=10.99, $p < .05$).

Identification of the Predictive Effect of the 21st Century Skills on Climate Literacy and the Regulatory Effect of the Giftedness Diagnosis on this Relationship

Prior to the predictive model analysis, initially, the relations between the 21st century skills, climate literacy, and the sub-dimensions of these variables were examined through the Pearson correlation analysis within the scope of preliminary analysis (Table 7).

On the whole, it was found that there was a strong positive relationship between 21st century skills and climate literacy (r=.53, $p < .01$). Similarly, it was observed that there were positive and significant correlations between the sub-dimensions of the related variables. For instance, it turned out that in individuals with cognitive skills, climatic awareness (r=.42, $p < .01$), climatic consciousness (r=.36, $p < .01$), and concept of climate (r=.39, $p < .01$) were higher. As is clear in Table 7, similar relationships were also observed between different correlation coefficients and other sub-dimensions.

Various regression analyses were applied in an attempt to see the predictive effect of the 21st century skills and giftedness diagnosis status on the climate literacy, as well as to identify whether giftedness diagnosis status had a moderator effect on the relationship between 21st century skills and climate literacy. Initially, in order to see the observed change in the variance explained by 21st century skills in climate literacy in general with the inclusion of giftedness diagnosis status in the regression model, the regulatory effect was analyzed by following the multivariate hierarchical (ordinal) regression procedure

Table 6.
Independent Sample t-Test Results on the Climate Literacy Scores of the Gifted and Undiagnosed Gifted Secondary School Students by Gender Variable

Gender	Sub-dimensions	Groups	N	$\bar{x}$	SD	df	t	p
Female	Concept of climate	Gifted students	98	3.89	0.17	200	6.65	.00
		Undiagnosed gifted students	104	3.59	0.42			
	Climatic awareness	Gifted students	98	3.91	0.19	200	7.67	.00
		Undiagnosed gifted students	104	3.47	0.55			
	Climatic consciousness	Gifted students	98	3.84	0.31	200	6.17	.00
		Undiagnosed gifted students	104	3.50	0.46			
	Overall scale	Gifted students	98	3.89	0.14	200	9.31	.00
		Undiagnosed gifted students	104	3.53	0.36			
Male	Concept of climate	Gifted students	85	3.87	0.24	172	6.52	.00
		Undiagnosed gifted students	89	3.50	0.46			
	Climatic awareness	Gifted students	85	3.93	0.24	172	9.20	.00
		Undiagnosed gifted students	89	3.27	0.63			
	Climatic consciousness	Gifted students	85	3.92	0.34	172	9.72	.00
		Undiagnosed gifted students	89	3.26	0.53			
	Overall scale	Gifted students	85	3.90	0.16	172	10.99	.00
		Undiagnosed gifted students	89	3.36	0.42			

Table 7.
21st Century Skills, Climate Literacy, and Their Correlation with the Sub-dimensions

	1	2	3	4	5	6	7	8
1. Cognitive	–							
2. Affective	.53**	–						
3. Sociocultural	.45**	.50**	–					
4. Concept of climate	.39**	.29**	.39**	–				
5. Awareness	.42**	.27**	.37**	.59**	–			
6. Consciousness	36**	.30**	.34**	.41**	.47**	–		
7. 21 century skills total	.85**	.82**	.76**	.44**	.44**	.41**	–	
8. Climate total	.48**	.35**	.45**	.83**	.87**	.72**	.53**	–

*Note: **p=< .001*

as suggested by Baron and Kenny (1986). In this sense, the 21st century skills, which was the main independent variable, were included in the regression equation in the first step. Subsequently, the giftedness diagnosis status as the moderator variable was attached to the model. In the third and final step, the 21st century skills × climate literacy interaction was enclosed to the model. At this point, a significant change in R^2 depending on the interaction (21st century skills × climate literacy) value demonstrated that there was a regulatory effect. Relevant hierarchical regression results are illustrated in Table 8.

As far as the results of the analysis are concerned, it is clear that the 21st century skills significantly and positively predicted the climate literacy in the first model ($\beta=.53$, $p = .00$) and explained 28% of the

Table 8.
Results of the Hierarchical Regression Analysis

Predictive	F	R^2	B	SE B	β	p
Model 1	145.44	.28				
21st century skills			.69	.06	.53	.00
Model 2	144.68	.44				
21st Century skills			.43	.06	.33	.00
Giftedness diagnosis			.33	.03	.44	.00
Model 3	98.25	.44				
21st century skills			.01	.23	.01	.97
Giftedness diagnosis			1.24	.49	1.65	.01
21st century skills X giftedness diagnosis			.24	.13	1.10	.06

total variance in the climate literacy ($F_{(1-375)}=145.44$, $p = .00$). In the second model, the 21st century skills and giftedness diagnosis together explained 44% of the variance in the climate literacy ($F_{(2-375)}=144.68$, $p = .00$), and it made a significant 16% contribution ($p < .01$) to the change in R^2 of the giftedness diagnosis status. In this model, it is clear that both the 21st century skills ($\beta=.33$, $p = .00$) and diagnoses status ($\beta=.44$, $p = .00$; Yes: 1, No: 0) significantly predict the climate literacy. In the last model, in which the interaction value was added, it was observed that the total variance explained in the climate literacy was 44%, and the contribution of the interaction to the total explained variance was less than 1% ($P = .06$). Both the insignificance of the change in R^2 depending on the interaction value and the insignificance of the interaction regression coefficient ($\beta=1.10$, $p = .06$) indicated that the diagnosis of special abilities did not have a regulatory role. Alongside the Baron and Kenny's (1986) traditional approach that explained the regulatory effect, resampling, which is a more modern method (Bootstrapping), the regression modeling tested above, was validated in Statistical Package for the Social Sciences Statistics software using the PROCESS macro (Model 1; Hayes, 2018) plugin. With the resampling technique used to calculate the confidence intervals of standard errors and regression coefficients, stronger and more accurate results were obtained in comparison to the traditional regression analyses (Preacher & Hayes, 2008). The results of the analysis are illustrated in Figure 1.
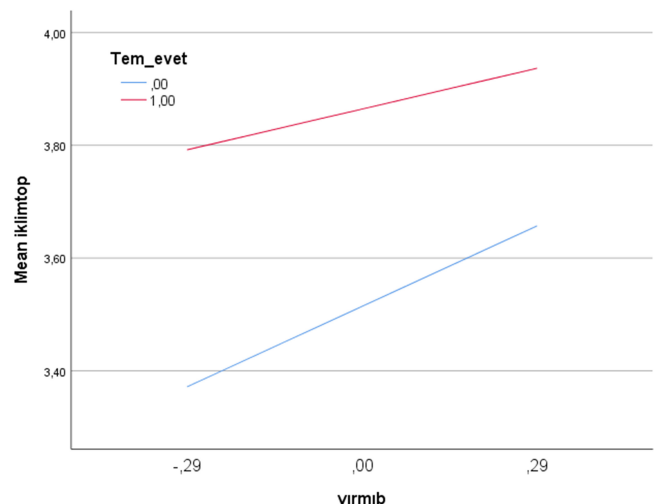

Figure 1.
The Change of the Relationship Between 21st Century Skills and Climate Literacy in Relation to the Giftedness Diagnosis.

Considering the results of the regulatory analysis using 10,000 resampling and 95% confidence intervals, it was found that both the 21st Century skills ($B = .49$, $p = .000$) and Giftedness Diagnosis Status ($B = .35$, $p = .000$; Yes: 1, No: 0) significantly predicted the climate literacy, but the interaction was insignificant ($B = -.24$; $p = .063$; 95% CI, $-.49$–$.01$). In other words, it is possible to say that gifted-diagnosed individuals had higher climate literacy skills. Nevertheless, the giftedness diagnosis status did not have a moderator effect on the relationship between 21st century skills and climate literacy (Figure 1).

Discussion

Discussion and Comments on the Comparison of the 21st Century Skills Scores of the Gifted and Undiagnosed Gifted Secondary School Students

According to the results obtained in this study, it was found that there was a significant differences in favor of the gifted in the 21st century skills scale overall and in the cognitive, affective, and sociocultural sub-dimensions. This particular result seemed to emerge from the fact that the gifted students had more different abilities and characteristics in cognitive, social, and emotional sub-dimensions than the undiagnosed gifted students (Clark, 2002). It is simply because the fact that the 21st century skills such as the management of knowledge in the cognitive domain, the ability to use mental reasoning, problem-solving, and high-level thinking skills were among the cognitive features that highlighted the giftedness status (Clark, 2002; Silverman, 2003), the fact that students' self-learning styles, goals, and strategies, such as commitment to the task and a high sense of responsibility in the affective field (Clark, 2002; Dabrowski, 1972; Gallagher, 1985; Gross, 1993; Karnes & Bean, 1996; Renzulli et al., 2002; Riley & Karnes, 1994; Roeper, 1988) were among the social and emotional characteristics that highlighted the gifted, and finally the fact that features such as global citizenship (Oğurlu et al., 2016) in the sociocultural field, fluent language and communication skills, leadership (Davis et al., 2014; Karnes & Bean, 1996; Renzulli et al., 2002), sensitivity to social issues, and tolerance for differences (Davaslıgil, 2004) were included in the relevant literature as qualities that brought the gifted to the fore clearly supported the results of this study. Self-regulation skills, which were believed to contribute to the ability of both gifted and undiagnosed gifted students to be more competent in areas such as planning and organization, decision-making, self-management, and planning skills, seemed to be among the 21st century skills as a key competence especially for the gifted students. With this strong internal drive, these individuals were more likely to restructure their environment in line with their learning needs (Risemberg & Zimmerman, 1992). This can be illustrated as one of the reasons for the difference in both cognitive and affective domains of the gifted students. Furthermore, the role of educational activities in the development of students participating in the study can be indicated as another reason for the difference. Especially in our country, it is possible to say that supporting the development of gifted students with project-based, differentiated education activities conducted in the Science and Art Centers in accordance with their interests, talents, and developmental characteristics had an impact.

Discussion and Comments on the Analysis of the 21st Century Skill Scores of the Gifted and Undiagnosed Gifted Secondary School Students by Gender Variable

It was found that there was a significant differences in favor of the gifted female and male students in all of the scores obtained from the cognitive domain, affective domain, sociocultural domain sub-dimensions in the 21st century skills scale and the overall scale. It is possible to say that the gifted male and female students perceived themselves more competent in structuring, managing, and using the knowledge as well as problem-solving skills in the cognitive domain, in self-management, and self-responsibility in the affective domain, and in social sensitivity and socialization ability in the sociocultural in comparison to their peers who were undiagnosed gifted students. It was established that the gifted male students used more complex and mental reasoning strategies in the cognitive domain than their peers who were undiagnosed gifted (Baltaci, 2016), and they demonstrated more effective cognitive flexibility in structuring and use of information (Vaivre-Douret, 2011). The strong desire to learn and develop cognitive structures have a significant impact over different areas of cognitive development of the gifted adolescents. In this period, cognitive features such as using creative skills to make quick connections between disciplines and making inferences on complex problems may be significant (Shore, 2000). The results obtained in this study and the differences in the cognitive domain of the male and female gifted students in comparison to their peers might be similar in this respect. Nevertheless, giftedness not only reflects the cognitive potential, but is also related to the affective and social development domains (Kanlı, 2011). Kramer (1985) reported that gifted female students utilized social interaction through social comparison in order to establish the scope of their abilities, prioritizing the quality of their achievement and social acceptability. Therefore, it was emphasized that gender differences in self-perception could also affect different areas of competence (VanTassel-Baska et al., 1994). Regarding the self-perception of peer relations, Košir et al. (2016) revealed that gifted males had higher competencies than their peers, and gifted female students had lower competencies than their peers who were undiagnosed gifted. In a different study, Hawkins (1992) compared the efficacy of gifted female students with respect to their peers and found that the gifted female students had a higher level of competence in taking self-responsibility. Sariçam and Şahin (2015) reported that gifted female students were extremely successful in adapting and were more competent in the sociocultural field because they assimilated the social values of the environment they lived in faster than their peers. Mayseless (1993), on the other hand, revealed in his study that gifted male and female high school students exhibited lower social skills than their peers. This might be due to the fact that the students participating in the study were at the high school level and demonstrated different social-emotional development characteristics.

Discussion and Comments on the Comparison of the Climate Literacy Skills Scores of the Gifted and Undiagnosed Gifted Secondary School Students

As far as the secondary school students who participated in the study are concerned, there was a significant differences in favor of the gifted students regarding the scores obtained from the general climate literacy scale and the sub-dimensions of the concept of climate, climatic awareness, and climatic consciousness. Climatic awareness was identified as the dimension in which gifted secondary school students expressed their views with the highest average on the climate literacy skills, and concept of climate and climatic consciousness were identified as the dimensions with the lowest average. The dimension of climatic awareness was the domain where awareness of the causes, effects, and possible consequences of climate change was emphasized. The higher sensitivity and awareness of the gifted in this domain could be associated with their sensitivity to social and global problems (Passow, 1988) and their enhanced sense of responsibility in this domain again (Tallent-Runnels & Yarbrough, 1992). The sensitivity that stood out in this process was among the features that distinguished the gifted from their peers who were undiagnosed gifted (Roeper, 1988). In the studies supporting this situation in the relevant literature, Nacaroğlu and Karaaslan (2020) reported that gifted students had a rich perception level toward climate change, while Park and Chung (2014) found that the components of the climatic systems that made up the world affected one another. On the other hand, Uğulu (2013) revealed that gifted students had higher attitudes toward the environment than their

peers who were undiagnosed gifted. Sanad et al. (2021) also reported that gifted students had an effect on climate change awareness in their study, which aimed to improve climate change awareness with a differentiated program developed for the gifted students.

As far as the undiagnosed gifted secondary school students are concerned, the dimension with the highest average opinion on climate literacy skills was the concept of climate, while the dimension with the lowest average opinion was the climatic awareness. The concept of climate dimension was the area that included the elements that made up the climate, climate types and characteristics, and basic competencies for weather events. It is possible to say that the sub-dimensions of climate literacy in the secondary school curriculum had an effect on the fact that students who were undiagnosed gifted in this dimension had a higher perception of efficacy compared to the other dimensions. It is simply because it was highlighted in the relevant literature that the "basic principles for the concept of climate," one of the dimensions that made up climate literacy in secondary school programs in Turkey, were taught to the students without establishing a relationship with climate change (Barak & Gönençgil, 2020). In similar studies supporting this particular result, while Ölger (2019) reported that students who were undiagnosed gifted had higher levels of being able to distinguish between weather and climate events compared to other dimensions, Oğuz-Hacat and Demir (2019) emphasized the importance of climate in social studies teaching programs in terms of sustainable development education. Furthermore, in the studies that did not overlap with the results obtained from this study and in the relevant literature in general, for instance, Arslan and Görgülü-Arı (2021) found that the climate literacy knowledge levels of the undiagnosed gifted secondary school students were at the level of "somewhat knowledgeable"; Ulu-Kalın (2018) revealed that they had high environmental literacy levels; and Özcan and Demirel (2019), on the other hand, reported that the greenhouse effect was one of the environmental problems they had the least knowledge of. In the light of the results obtained, it is possible to say that it was significant that climate change, which is one of the important problems of our age today, was included more in secondary school curricula both in terms of climatic awareness, and climatic consciousness dimensions, as well as allowing for more opportunities for practice-based activities for the students.

Discussion and Comments on the Examination of the Climate Literacy Skills Scores of the Gifted and Undiagnosed Gifted Secondary School Students by Gender Variable

Within the scope of the present study, there was a significant differences in favor of the gifted female and male students in all of the scores obtained from the concept of climate, climatic awareness, and climatic consciousness sub-dimensions in the climate iteracy Scale and the overall scale. It was found that regarding the dimension of concept of climate, the gifted male and female students perceived themselves as more competent than their peers in relation to such issues as how the climate was formed, developing solutions for climate problems, in the competencies regarding the factors that disrupted the climate balance, doing research on the hazards of the climatic changes in the dimension of climatic consciousness and producing solutions to prevent them, and finally in the competencies to take part in projects. Even though the studies on climate literacy are limited in the relevant literature, it was found that the climate issue was mostly discussed in the context of environmental sensitivity. According to this, Uğulu (2013), who reported that there was a significant difference in the attitudes of gifted and ungifted female students at secondary school level toward the environment, found that this difference was in favor of the diagnosed gifted female students. In the same study, it was also found that there was no significant difference between the male students who were diagnosed gifted and undiagnosed gifted.

It is possible to say that this particular finding of the general results has come from the differences in the attitudes and proficiency of the student groups participating in the study on environmental education. Gifted students' interest in the environment requires strong observation, healthy reasoning, and creative thinking skills. In this sense, it is essential to carry out educational practices at an earlier age for the development of climatic literacy. In addition to the gifted students, one of the prominent issues in the views (Aydın, 2014; Demirbaş & Pektaş, 2009) of gifted and undiagnosed gifted male and female students on the climate change and global warming might be the misconceptions that emerged in the students. It is possible to say that the most common misconceptions on this subject focused on the causes of global warming, the effects of global warming, and climate changes (Shepardson et al., 2012). Particularly, by identifying the basic competencies and knowledge deficiencies of the students in this field, the reasons underlying the misconceptions can be highlighted, and the educational processes for climate literacy skills can be implemented more deeply with a new discipline area.

Discussion and Comments on the Predictive Effect of the 21st Century Skills on Climate Literacy and the Regulatory Effect of the Giftedness Diagnosis Status on this Relationship

Considering the results of the regression analysis conducted within the scope of the study, it was found that the 21st century skills and giftedness diagnosis status significantly predicted the climate literacy. These two variables explicated 44% of the variance of the climate literacy. Another result of the study was that the giftedness diagnosis status did not have a regulatory effect on the relationship between 21st century skills and climate literacy. In the national and international studies done on the 21st century skills, it is clear to see that the climate literacy skills were generally associated with environmental literacy (MEB, 2023; P21, 2007).

Global Awareness and Environmental Literacy are the themes associated with the science courses within the context of the 21st Century Learning Framework created internationally. Both themes have an important place as the 21st century skills in a better understanding of the academic content in science courses in the universal sense (Aydın-Ceran, 2021), and at the same time, many of the skills around these themes are included in the curriculum of many countries in the world (Gelen, 2017). Parallel to these studies in Turkey, at the secondary school level, under the "Global Connections" learning domain in the Social Studies Curriculum (Demir, 2019; Özkaral, 2019), regarding the form of achievements in different units in the Science Curriculum (Aydın-Ceran, 2021), a separate program was created under the name of Environmental Education and Climate Change Course. The skills in this program were classified as "scientific process skills" and "life skills." The common purpose of the developed programs was to train individuals who produced and used knowledge, had problem-solving skills, as well as entrepreneurial and communication skills (MEB, 2022). Yakar and Karakuş (2019) emphasized that the Social Studies Curriculum included more topics and achievements related to climate literacy, and that individuals' decision-making skills, which revealed the effects of their decisions on climate change, could be acquired more effectively. Therefore, it is possible to say that the competencies discussed in this study are among the basic elements of the curriculum and this situation can contribute positively to the climate literacy of the competencies of the gifted-diagnosed secondary school students for the 21st century skills. General education programs are less effective than the programs prepared for the gifted and their interests. The gifted students need a differentiated program that suits their individual characteristics, interests, needs, and abilities. In the programs developed for the gifted students, it is aimed to transform the creative products into learning by using advanced content, analysis of abstract themes, and high-level thinking skills (Emir, 2021). Gifted students' interest in

the environment requires strong observation, healthy reasoning, and creative thinking skills. In this sense, it comes to the fore that educational practices should be carried out at an earlier age to develop climatic literacy. In this context, when the results obtained in the research are evaluated, it can be shown that the instructional interventions and learning needs of gifted students are not adequately met.

Recommendations

In line with the results obtained from the present study, the following recommendations have been offered:

1. Studies can be conducted in the future to reveal the 21st century skills of gifted and undiagnosed gifted students studying at different levels at primary, secondary, and high school levels.
2. Studies can be conducted in order to identify the climate literacy skills of gifted and undiagnosed gifted students studying at different levels at primary, secondary, and high school levels.
3. It is possible to recommend conducting both qualitative research designs and mixed studies in order to reveal both the 21st century and climate literacy skills of the secondary school students more comprehensively.

References

Akhan N. E., Çiçek S., & Kocaağa G. (2022) Critical and creative perspectives of gifted students on global problems: Global climate change. *Thinking Skills and Creativity 46*, 1-15. Available at: [CrossRef]

Arslan, K., & Görgülü-Arı, A. (2021). İklim okuryazarlığına yönelik ortaokul öğrencilerinin kendilerini algılama düzeyleri. *Sürdürülebilir Çevre Dergisi*, *1*(2), 1–12. https://dergipark.org.tr/tr/pub/cevder/issue/67695/892021

Aydemir, Z., Sakız, G., & Doğan, M. C. (2019). İlkokul düzeyinde dijital okuryazarlık becerileri rubriğinin geliştirilmesi. *Milli eğitim dergisi*, *48*(1), 617–638. https://dergipark.org.tr/tr/pub/milliegitim/issue/51765/674576

Aydın, F. (2014). Ortaöğretim öğrencilerinin küresel ısınma konusundaki bilgi düzeylerinin belirlenmesi [Determination of knowledge level of high school students on global warming subject]. *Turkish Journal of Education*, *3*(17346), 15–27. [CrossRef]

Aydın, F., Coskun, M., Kaya, H., & Erdönmez, I. (2011). Gifted students' attitudes towards environment: A case study from Turkey. *African Journal of Agricultural Research*, *6*(7), 1876–1883. [CrossRef]

Aydın-Ceran, S. (2021). 21. Yüzyıl becerileri bağlamında fen eğitiminin bugünü ve geleceği: Türkiye perspektifinde bir analiz. *Insan ve Toplum Bilimleri Araştırmaları Dergisi*, *10*(4), 3191–3218. http://www.itobiad.com/tr/pub/issue/66167/908645

Baltaci, S. (2016). Examination of gifted students' probability problem solving process in terms of mathematical thinking. *Malaysian Online Journal of Educational Technology*, *4*(4), 18–35. Retrieved from https://files.eric.ed.gov/fulltext/EJ1116211.pdf

Barak, B., & Gönençgil, B. (2020). Dünyada ve Türkiye'de ortaokul öğretim programlarının iklim değişikliği eğitimi yaklaşımına göre karşılaştırılması. *Coğrafya Dergisi*, *40*, 187–201. [CrossRef]

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1182. [CrossRef]

Başar,S. (2018). *Fen bilimleri öğretmen adaylarının fende matematiğin kullanımına yönelik özyeterlik inançları, 21.yy becerileri ve aralarındaki ilişkinin incelenmesi* (Tez No. 515625, Yüksek Lisans Tezi). Hacettepe Üniversitesi, Yükseköğretim Kurulu Ulusal Tez Merkezi.

Beers, S. Z. (2011). *21st century skills Preparing students for their future*. https://www.mheonline.com/mhmymath/pdf/21st_century_skills.pdf

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., & Rumble, M. (2010). *Defining 21st century skills*. http://atc21s.org/index.php/resources/white-papers/#item1

Bozkurt, Ş. B., & Çakır, H. (2016). Ortaokul öğrencilerinin 21.yüzyıl öğrenme beceri düzeylerinin cinsiyet ve sınıf seviyesine göre incelenmesi. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, *39*, 69–82. https://dergipark.org.tr/tr/download/article-file/399386

Büyüköztürk, Ş. (2011). *Sosyal bilimler için veri analizi el kitabı*. Pegem Akademi.

Büyüköztürk, Ş., Kılıç-Çakmak, E., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2015). *Bilimsel araştırma yöntemleri*. Pegem Yayıncılık.

Çetin, M., & Çetin, G. (2021). 21. yüzyıl becerileri açısından MEB okul öncesi eğitim programına eleştirel bir bakış. *Yaşadıkça Eğitim*, *35*(1), 235–255. [CrossRef]

Clark, B. (2002). *Growing up gifted* (6th ed). Pearson Education. https://libgen.is/book/index.php?md5=E59323830403B3F46624EFA98FBDAFF7

Çolak, M. (2018). *Ortaokul fen bilimleri dersinin 21.yüzyıl becerilerini kazandırmadaki etkililiğine ilişkin öğretmen görüşleri (Kayseri İli Örneği)* (Yüksek Lisans Tezi, Tez No.490559). Erciyes Üniversitesi, Yükseköğretim Kurulu Ulusal Tez Merkezi.

Cross, T. L. (2011). *On the social and emotional lives of gifted children*. Prufrock press Inc. https://libgen.is/book/index.php?md5=641DD5BF51269EEDF82397026BDE8A4C

Dabrowski, K. (1972). *Psychoneurosis is not an illness*. Gryf. https://libgen.rocks/ads.php?md5=4AC9F452A1CBA8FF789A9F1209A02F24

Davaslıgil, Ü. (2004). *Milli eğitim bakanlığı özel eğitim ve Rehberlik dairesi başkanlığı*. Üstün Yetenekli Çocuklar ve Eğitimleri. Ön Rapor.

Davis, G. A., Rimm, S., & Siegle, D. (2014). *Education of the gifted and talented*. Pearson. https://libgen.rocks/ads.php?md5=BC453774D20D44AD608A395EDCC985BB#google_vignette

Demir, H. (2019). *2018 Sosyal Bilgiler öğretim programında ve ders kitaplarında iklim değişikliği* (Yüksek Lisans Tezi, Tez No.582995). Ankara Üniversitesi, Yükseköğretim Kurulu Ulusal Tez Merkezi.

Demirbaş, M., & Pektaş, H. M. (2009). İlköğretim öğrencilerinin cevre sorunu ile ilişkili temel kavramları gerçekleştirme duzeyleri [Elementary students' levels of realization of basic concepts related with environment problem]. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education*, *3*(2), 195–211. https://dergipark.org.tr/en/pub/balikesirnef/issue/3369/46511

DeWaters, J. E., Andersen, C., Calderwood, A., & Powers, S. E. (2014). Improving climate literacy with project-based modules rich in educational rigor and relevance. *Journal of Geoscience Education*, *62*(3), 469–484. [CrossRef]

Dinler, H., Simsar, A., & Yalçın, V. (2021). 3-6 Yaş çocukların 21. yüzyıl becerilerinin bazı değişkenler açısından incelenmesi. *E-Kafkas Journal of Educational Research*, *8*(2), 281-303. [CrossRef]

Doğar, Ç., & Başıbüyük, A. (2005). İlköğretim ve ortaöğretim öğrencilerinin hava ve iklim olaylarını anlama düzeyleri. *Kastamonu Eğitim Dergisi*, *13*(2), 347–358. https://search.trdizin.gov.tr/tr/yayin/detay/117142/ilkogretim-ve-ortaogretim-ogrencilerinin-hava-ve-iklim-olaylarini-anlama-duzeyleri

Emir, S. (2021). *Üstün zekalı ve yetenekliler için program farklılaştırma*. Vize Akademik Yayıncılık.

Galbraith, J. (1985). The eight great gripes of gifted kids: Responding to special needs. *Roeper Review*, *8*(1), 15–18. [CrossRef]

Gallagher, S. A. (1985). A comparison of the concept of overexcitabilities with measures of creativity and school achievement in sixth grade students. *Roeper Review*, *8*(2), 115–119. [CrossRef]

Gelen, İ. (2017). P21-Program ve öğretimde 21.yüzyıl beceri çerçeveleri (ABD Uygulamaları). *Disiplinlerarası Eğitim Araştırmaları Dergisi*, *1*(2), 15–29. https://dergipark.org.tr/tr/pub/jier/issue/33877/348852

George, D., & Mallery, M. (2010). *SPSS for Windows step by step: A Simple guide and reference*. Pearson.

Göktepe-Yıldız, S. (2020). Lise öğrencilerinin 21. yüzyıl becerilerinin bazı demografik değişkenler açısından incelenmesi. *Ulakbilge*, *51*, 884–897. [CrossRef]

Görgülü-Arı, A., & Arslan, K. (2020). İklim okuryazarlığı ölçeği geliştirme çalışması. *Journal of Academic Social Science Studies*, *82*, 147–174. [CrossRef]

Gross, M. U. M. (1993). *Exceptionally gifted children*. Routledge.

Hawkins, D. G. (1992). *Personality factors affecting achievement in achieving gifted, underachieving gifted, and nongifted elementary students* (Unpublished Master Thesis). The University of Florida.

Hayes, A. F. (2018). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford Press.

Iowa Core (2010). *K-12 21st century skills*. https://iowacore.gov/standards/21st-century-skills/k-1-2-3-4-5-6-7-8-9-10-11-12/21st-century-skills

International Society for Technology in Education [ISTE] (2016). *ISTE standards: Students*. http://iste.org/standards

Kalkınma Ajansları (2020). https://ka.gov.tr/sayfalar/kalkinma-planlamasinda-istatistiki-bolge-birimleri-siniflandirmasi--24

Kan'an, A. (2018). The relationship between Jordanian students' 21 st century skills (cs21) and academic achievement in science. *Journal of Turkish Science Education (TUSED)*, *15*(2), 82–94. https://files.eric.ed.gov/fulltext/EJ1313753.pdf

Kang, M., Heo, H., Jo, I., Shin, J., & Seo, J. (2010). Developing an educational performance indicator for new millennium learners. *Journal of Research on Technology in Education*, *43*(2), 157–170. [CrossRef]

Kanlı, E. (2011). Üstün zekâlı ve normal lise öğrencilerin mükemmeliyetçilik, depresyon ve kaygı düzeyleri arasındaki ilişkilerinin incelenmesi. *M.Ü. Atatürk Eğitim Fakültesi Eğitim Bilimleri Dergisi*, *33*, 103–121. https://dergipark.org.tr/tr/download/article-file/1714

Karakaş, M. M. (2015). *Ortaokul sekizinci sınıf öğrencilerinin fen bilimlerine yönelik 21.yüzyıl beceri düzeylerinin ölçülmesi* (Yüksek Lisans Tezi, Tez No. 391151). Eskişehir Osman Gazi Üniversitesi, Yükseköğretim Kurulu Ulusal Tez Merkezi.

Karakaş, M. M., & Anagün, Ş. S. (2020). A Scale adaptation and application study for secondary school students' 21st century skills. In H.Şirin (Ed.). *Educational sciences theory, current researches and new trends* (pp.118–143). Cetinje.

Karakuş, U. (2006). *Coğrafya'da iklim konularının öğretiminde deney yöntemi-nin öğrenci başarı düzeyine etkisi* (Yayımlanmamış Doktora Tezi, Tez No.211243). Gazi Üniversitesi], Yükseköğretim Kurulu Ulusal Tez Merkezi.

Karnes, F. A., & Bean, S. M. (1996). Leadership and gifted. *Focus on Exceptional Children*, *29*(1), 1–13. [CrossRef]

Košir, K., Horvat, M., Aram, U., & Jurinec, N. (2016). Is being gifted always an advantage? Peer relations and self-concept of gifted students. *High Ability Studies*, *27*(2), 129–148. [CrossRef]

Kramer, L. (1985). *Social interaction and perceptions of ability: A study of gifted adolescent females* (ED262535). Educational Resources Information Center. https://eric.ed.gov/?id=ED262535

Mayseless, O. (1993). Gifted adolescents and intimacy in close same-sex friendships. *Journal of Youth and Adolescence*, *22*(2), 135–146. [CrossRef]

Milli Eğitim Bakanlığı [MEB] (2022). *Çevre eğitimi ve iklim değişikliği dersi öğretim programı* (Publication No.10). Milli Eğitim Bakanlığı Temel Eğitim Genel Müdürlüğü http://mufredat.meb.gov.tr/Dosyalar/20224410271062 8-2022-10-cevre-egitimi-iklim-degisikligi-ogretim-programi-web.pdf

Milli Eğitim Bakanlığı [MEB] (2023). *21.Yüzyıl becerileri ve değerlere yönelik araştırma raporu*. Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu Başkanlığı. https://ttkb.meb.gov.tr/meb_iys_dosyalar/2023_05/111535 21_21.yy_becerileri_ve_degerlere_yonelik_arastirma_raporu.pdf, *21*

Mochizuki, Y., & Bryan, A. (2015). Climate change education in the context of education for sustainable development: Rationale and principles. *Journal of Education for Sustainable Development*, *9*(1), 4–26. [CrossRef]

Murat, M. (2018). *Ters yüz sınıf modelinin beşinci sınıf öğrencilerinin 21.yüzyıl becerileri ve bilimsel epistemolojik inançlarına etkisi* (Yüksek Lisans Tezi, Tez No. 542404). Muğla Sıtkı Koçman Üniversitesi, Yükseköğretim Kurulu Ulusal Tez Merkezi.

Mutlu, F., & Nacaroğlu, O. (2019). Examination of perceptions of gifted students about climate change and global warming. *Journal of Baltic Science Education*, *18*(5), 780–792. [CrossRef]

Nacaroğlu, O. (2020). Özel yetenekli ve normal gelişim gösteren öğrencilerin 21. yüzyıl becerilerinin incelenmesi. *Ankara University Journal of Faculty of Educational Sciences (JFES)*, *53*(2), 693–722. [CrossRef]

Nacaroğlu, O., & Karaaslan, G. (2020). Özel yetenekli öğrencilerin iklim değişikliğine yönelik bilişsel yapılarının incelenmesi. *Gümüşhane Üniversitesi Sosyal Bilimler Enstitüsü Elektronik Dergisi*, *11*(Ek), 1–13. https://dergipark.org.tr/en/download/article-file/838437

O'Brien, M., & Rugen, L. (2001). *Teaching literacy in the turning points school. Turning points: Transforming middle schools*. Center for collaborative education.

Oğurlu, Ü., Kaya, F., Ercan Yalman, F., & Ayvaz, Ü. (2016). Üstün yetenekli ortaokul öğrencilerine küresel vatandaşlık eğitimi programının etkililiği. *Mersin Üniversitesi Eğitim Fakültesi Dergisi*, *12*(1). [CrossRef]

Oğuz-Hacat, S., & Demir, F. B. (2019). Sürdürülebilir kalkınma eğitimi açısından Sosyal Bilgiler dersi öğretim programının değerlendirilmesi. *Diyalektolog Ulusal Sosyal Bilimler Dergisi*, *22*, 211–225. [CrossRef]

Ölger, N. (2019). *Ortaokul 7.sınıf öğrencilerinin iklim değişikliği konusundaki informal muhakemelerinin incelenmesi* (Yüksek Lisans Tezi, Tez No.594080). Aksaray Üniversitesi, Yükseköğretim Kurulu Ulusal Tez Merkezi.

Önür, Z., & Kozikoğlu, İ. (2019). Ortaokul öğrencilerinin 21.yüzyıl öğrenme becerileri. *Trakya Eğitim Dergisi*, *9*(3), 627–648. [CrossRef]

Organisation for Economic Co-operation and Development [OECD] (2018). *The Future of education and skills: Education 2030*. https://www.oecd.org/education/2030/E2030%20Position%20Paper%20pdf

Özarslan, M. (2020). A Comparison of gifted and non-gifted students' perceptions concerning plants through metaphors. *International Electronic Journal of Environmental Education*, *10*(1), 1–15. https://dergipark.org.tr/en/download/article-file/844394

Özcan, H., & Demirel, R. (2019). Ortaokul öğrencilerinin çevre sorunlarına yönelik bilişsel yapılarının çizimleri aracılığıyla incelenmesi. *Başkent University Journal of Education*, *6*(1), 68–83. http://buje.baskent.edu.tr/index.php/buje/article/view/164

Özkaral, T. C. (2019). Küresel ısınma ve iklim değişikliği konusunun Türkiye, Kanada (Ontario) ve Hong Kong sosyal bilgiler öğretim programlarında karşılaştırmalı olarak incelenmesi. *International Journal of Education Technology and Scientific Researches*, *4*(8), 1–14. https://ijetsar.com/Makaleler/1487572266_1.%20114%20tu%c4%9fba%20cevriye%20%c3%b6zkaral.pdf

Partnership for 21st Century Learning [P21] (2007). *Framework for 21st Century Learning*. http://www.p21.org/ourwork/p21framework% http://www.p21.org/about-us/p21-framework

Park, K. J., & Chung, D. H. (2014). The characteristics of earth system thinking of science gifted students in relation to climate changes. *Journal of Gifted/Talented Education*, *24*(2), 271–288. [CrossRef]

Passow, A. H. (1988). Educating gifted persons who are caring and concerned. *Roeper Review*, *11*(1), 13–15. [CrossRef]

Piechowski, M. M. (1997). Emotional giftedness: The measure of intrapersonal intelligence. In N. Colangelo & G. Davis (Eds.), *Handbook of gifted education* (2th ed, pp. 366–381). Allyn &Bacon. https://libgen.is/book/index.php?md5=B175AFF0526CAB9E3C8822BD5CAB0813

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, *40*(3), 879–891. [CrossRef]

Reis, S. M., & Moon, S. M. (2002). Models and strategies for counseling, guidance and social and emotinal support of gifted and talented students. In M. Neihart, S. M. Reis, N. M. Robinson & S. M. Moon (Eds.), *The Social and emotional development of gifted children: What do we know?* (pp.251–266). National Association for Gifted Children. https://libgen.is/book/index.php?md5=080ACDA4D19AF16C5D94C294A95FDBDD

Renzulli, J. S., Smith, L. H., White, A. J., Callahan, C. M., Hartman, R. K.,Westberg, K. L., Gavin, M. K., Reis, S. M., Siegle, D., & Reed, R. R. S. (2002). *Scales for rating the behavioral characteristics of superior students*. Creative Learning Press. https://libgen.rocks/ads.php?md5=CC910EA454443DA612C546AB59B56269#google_vignette

Riley, T. L., & Karnes, F. A. (1994). Intellectually gifted elementary students' perceptions of leadership. *Perceptual and Motor Skills*, *79*(1 Pt 1), 47–50. [CrossRef]

Risemberg, R., & Zimmerman, B. J. (1992). Self-regulated learning in gifted students. *Roeper Review*, *15*(2), 98–101. [CrossRef]

Roeper, A. (1988). Should educators of the gifted and talented be more concerned with world issues? *Roeper Review*, *11*(1), 12–13. [CrossRef]

Sanad, F. S, Aljasim, F. A., & AlHendal, H. S. (2021) The effect of an enrichment unit on climate change awareness and basic science process skills among gifted female primary school students. *International Journal of Childhood, Counselling and Special Education*, *3*(1), 32–46. [CrossRef]

Sak, U. (2011). Üstün yetenekliler eğitim programları modeli (ÜYEP) ve sosyal geçerliliği. *Eğitim ve Bilim*, *36*(161), 1–17. http://egitimvebilim.ted.org.tr/index.php/EB/article/view/893

Sariçam, H., & Şahin, S. H. (2015). The relationship between the environmental awareness, environmental attitude, curiosity and exploration in highly gifted students: Structural equation modelling. *Educational Process: International Journal*, *4*(1–2), 7–17. [CrossRef]

Schroth, S. T., & Helfer, J. A. (2017). Gifted & green: Sustainability/environmental science investigations that promote gifted children's learning. *Gifted Child Today*, *40*(1), 14–28. [CrossRef]

Shepardson, D. P., Niyogi, D., Roychoudhury, A., & Hirsch, A. (2012). Conceptualizing climate change in the context of a climate system: Implications for climate and environmental education. *Environmental Education Research*, *18*(3), 323–352. [CrossRef]

Shore, B. M. (2000). Metacognition and flexibility: Qualitative differences in how gifted children think. In R. C. Friedman & B. M. Shore (Eds.), *Talents unfolding: Cognition and development* (pp. 167–187). American Psychological Association. [CrossRef]

Silverman, L. K. (1994). The moral sensitivity of gifted children and the evolution of society. *Roeper Review*, *17*(2), 110–116. [CrossRef]

Silverman, L. K. (2003). *Characteristics of Giftedness Scale: Research and Review of the Literature*. Available from the Gifted Development Center website. http://www.gifteddevelopment.com.

Tallent-Runnels, M. K., & Yarbrough, D. W. (1992). Effects of the future problem solving program on children's concerns about the future. *Gifted Child Quarterly*, *36*(4), 190–194. [CrossRef]

U.S. Global Change Research Program [USGCRP] (2009). *Climate literacy: The essential principles of climate sciences*. National Oceanic and Atmospheric Administration.

Uğulu, İ. (2013). Üstün zekalı/yetenekli öğrenciler ile normal gelişim gösteren öğrencilerin çevreye yönelik tutumlarının karşılaştırılması. *Buca Eğitim Fakültesi Dergisi*, *35*, 1–13. https://dergipark.org.tr/tr/download/article-file/231563

Ulu-Kalın, Ö. (2018). Ortaokul öğrencilerinin çevre okuryazarlık düzeylerinin belirlenmesi (Artvin İl Örneği). *Avrasya Uluslararası Araştırmalar Dergisi*, *6*(13), 155–170. [CrossRef]

Vaivre-Douret, L. (2011). Developmental and cognitive characteristics of high-level potentialities (highly gifted) children. *International Journal of Pediatrics*, *2011*, 420297. [CrossRef]

Van der Meulen, R. T., Van der Bruggen, C. O., Spilt, J. L., Verouden, J., Berkhout, M., & Bögels, S. M. (2014). The pullout program day a week school for gifted children: Effects on social–emotional and academic functioning. In *Child and Youth Care Forum*, *43*(3), 287–314. https://psycnet.apa.org/doi/10.1007/s10566-013-9239-5. [CrossRef]

VanTassel-Baska, J., Olszewski-Kubilius, P., & Kulieke, M. (1994). A study of self-concept and social support in advantaged and disadvantaged seventh and eighth grade gifted students. *Roeper Review*, *16*(3), 186–191. [CrossRef]

Voogt, J., & Roblin, N. P. (2012). A comparative analysis of international frameworks for 21st century competences: Implications for national curriculum policies. *Journal of Curriculum Studies*, *44*(3), 299–321. [CrossRef]

Wagner, T. (2008). *The global achievement gap: Why even our best schools don't teach the new survival skills our children need-and what we can do about it*. https://libgen.is/book/index.php?md5=4E01C1A42529530D48399D3B3E54B44E

Wibeck, V. (2014). Enhancing learning, communication and public engagement about climate change– some lessons from recent literature. *Environmental Education Research*, *20*(3), 387–411. [CrossRef]

Yakar, H., & Karakuş, U. (2019). Investigation of the social studies curricula in Turkey (1968–2018) with regards to the climate literacy principles. *Universal Journal of Educational Research*, *7*(5), 1216–1225. [CrossRef]

Yakar, H., & Karakuş, U. (2020). İklim Okuryazarlığı yeterliklerinin belirlenmesi: Ortaokul düzeyine yönelik bir delphi çalışması. *Eğitim ve Bilim*, *45*(203), 45–62. http://egitimvebilim.ted.org.tr/index.php/EB/article/view/8647